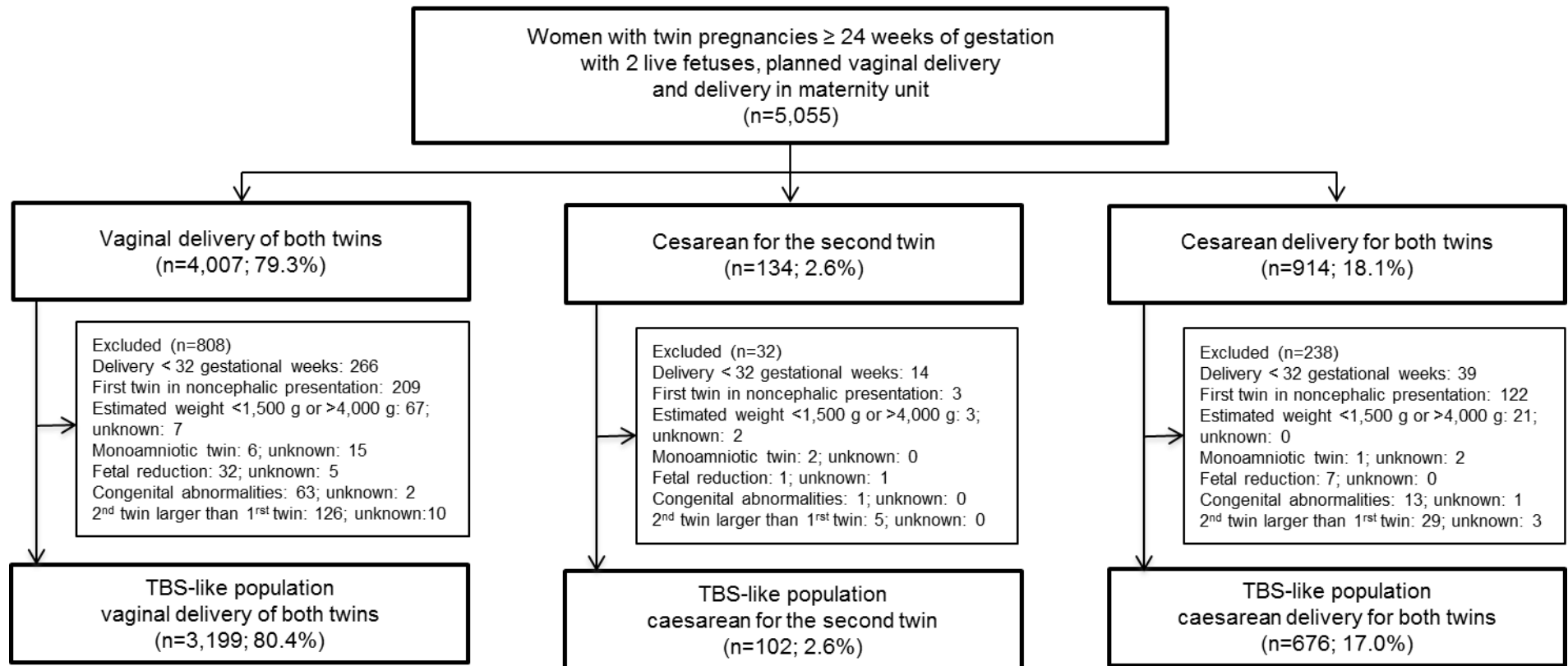


Severe maternal morbidity by mode of delivery in women with twin pregnancy and planned vaginal delivery

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SUPPLEMENTARY INFORMATION

Figure S1: Flow chart for the Twin Birth Study-like population



TBS, Twin Birth Study

Table S1: Details of maternal, pregnancy, labor and delivery characteristics of the main population according to mode of delivery

	Vaginal delivery of both twins	Cesarean delivery for the second twin	<i>P</i>	Cesarean delivery for both twins	<i>P</i>
	n=4,007	n=134		n=914	
	n (%)	n (%)		n (%)	
Age (mean ± SD, years)	31.1±5	31.2±5	0.832	32.2±6	<0.001
<30	1,499 (37.4)	50 (37.3)	0.992	310 (34.0)	<0.001
[30-34]	1,540 (38.4)	51 (38.1)		313 (34.2)	
≥35	968 (24.2)	33 (24.6)		291 (31.8)	
BMI before pregnancy (mean±SD, Kg.m-2)	23.7±4.7	24.3±5.4	0.193	23.7±4.6	0.905
<18.5	257 (6.7)	9 (7.3)	0.470	60 (6.8)	0.932
[18.5-25[2,432 (63.4)	71 (57.3)		573 (64.4)	
[25-30[763 (19.9)	27 (21.8)		169 (18.9)	
≥30	387 (10.1)	17 (13.7)		88 (9.9)	
Parity and previous cesareans			0.745		<0.001
Nulliparous	1,704 (42.6)	55 (41.0)		644 (70.5)	
Parous with no previous cesarean	2,158 (54.0)	73 (54.5)		208 (22.8)	
Parous with previous cesarean	133 (3.3)	6 (4.5)		61 (6.7)	
Geographic region of birth			0.757		0.423
Europe	2,958 (82.4)	104 (86.0)		642 (80.4)	
North Africa	377 (10.5)	11 (9.1)		85 (10.7)	
Africa other	201 (5.6)	5 (4.1)		53 (6.6)	
Other	55 (1.5)	1 (0.8)		18 (2.3)	
Smoker	563 (14.6)	25 (20.0)	0.091	118 (13.3)	0.343
History of diabetes	18 (0.5)	0 (0.0)	0.436	7 (0.8)	0.225
History of hypertension	27 (0.7)	1 (0.7)	0.922	10 (1.1)	0.184
In vitro fertilisation	776 (19.5)	31 (23.1)	0.294	296 (32.5)	<0.001
Fetal reduction ≥ 13 weeks gestation	37 (0.9)	1 (0.8)	0.836	11 (1.2)	0.442
Chorionicity			0.164		0.287
Dichorionic	3,200 (80.2)	112 (84.8)		754 (82.7)	
Monochorionic/diamnionic	783 (19.6)	20 (15.2)		157 (17.2)	
Monochorionic/monoamnionic	7 (0.2)	0 (0.0)		1 (0.1)	
Pregnancy complications	883 (22.1)	28 (21.1)	0.773	282 (30.9)	<0.001
Hypertension	155 (3.9)	5 (3.8)		61 (6.7)	

Preeclampsia	230 (5.8)	6 (4.5)		123 (13.5)	
Bleeding	34 (0.9)	2 (1.5)		13 (1.4)	
Placental abruption	2 (0.1)	0 (0.0)		2 (0.2)	
IUGR for either twin	413 (10.3)	14 (10.5)		112 (12.3)	
Insulin-treated diabetes	112 (2.8)	4 (3.0)		33 (3.6)	
Placenta praevia	8 (0.2)	0 (0.0)		1 (0.1)	
Malformation for either twin	81 (2.0)	2 (1.5)		21 (2.3)	
Twin-to-twin transfusion syndrome	56 (1.4)	0 (0.0)		9 (1.0)	
Premature rupture of membranes	390 (9.8)	14 (10.6)	0.750	71 (7.8)	0.064
Preterm labor	1,550 (38.8)	48 (36.4)	0.577	255 (27.9)	<0.001
Antenatal corticosteroids	1,792 (44.9)	53 (39.8)	0.250	329 (36.1)	<0.001
Induction of labor	1,685 (42.1)	38 (28.4)	0.002	571 (62.7)	<0.001
Oxytocin during labor	2,776 (70.2)	82 (61.7)	0.034	670 (75.4)	0.002
Non-cephalic second-twin presentation	1,604 (40.1)	64 (47.8)	0.075	376 (41.4)	0.483
Gestational age at delivery (weeks days) (mean)	36 1/7	35 4/7	0.024	36 5/7	<0.001
<32 0/7	266 (6.6)	14 (10.4)	0.124	39 (4.3)	<0.001
32 0/7-36 6/7	1,783 (44.5)	66 (49.3)		334 (36.6)	
≥ 37 0/7	1,955 (48.8)	54 (40.3)		540 (59.1)	
Intertwin delivery interval (median (Q1-Q3), minutes)	6 [4-9]	19 [9-58]	<0.001	1 [1-2]	<0.001
General anaesthesia at 2 nd twin delivery	30 (0.8)	37 (27.6)	<0.001	51 (5.6)	<0.001
Instrumental vaginal delivery for 1 st twin	751 (18.8)	32 (23.9)	0.137	NA	NA
Instrumental vaginal delivery for 2 nd twin	602 (15.0)	0 (0.0)		NA	NA
Episiotomy	905 (22.7)	28 (20.9)	0.630	NA	NA
Birth weight 1 st twin (mean±SD, grams)	2,381.7±524.0	2,276.6±559.7	0.023	2,488.1±510.6	<0.001
Birth weight 2 nd twin (mean±SD, grams)	2,336.4±516.3	2,255.1±568.1	0.076	2,413.5±504.5	<0.001
Macrosomia	447 (11.2)	14 (10.6)	0.837	138 (15.1)	0.001
Annual number of twin deliveries			0.066		0.038
<50	1,360 (33.9)	57 (42.5)		272 (29.8)	
[50-99]	1,098 (27.4)	37 (27.6)		255 (27.9)	
≥100	1,549 (38.7)	40 (29.9)		387 (42.3)	
University hospital	1,883 (47.0)	52 (38.8)	0.062	471 (51.5)	0.013
Level of care			0.005		0.043

I	73 (1.8)	7 (5.2)		18 (2.0)	
II	1,488 (37.2)	57 (42.5)		299 (32.7)	
III	2,446 (61.0)	70 (52.2)		597 (65.3)	

BMI: Body mass index

SD: standard deviation

IUGR: in utero growth restriction

Table S2: Maternal, pregnancy, labor and delivery characteristics of the Twin Birth Study-like population according to mode of delivery

	Vaginal delivery	Cesarean delivery	<i>P</i>	Cesarean delivery	<i>P</i>
	of both twins	for the second twin		for both twins	
	n=3,199	n=102		n=676	
	n (%)	n (%)		n (%)	
Age (mean ± SD, years)	31.2±5.0	31.1±4.6	0.911	32.3±5.7	<0.001
<30	1,165 (36.4)	36 (35.3)	0.482	231 (34.3)	0.001
[30-34]	1,241 (38.8)	45 (44.1)		229 (33.8)	
≥35	792 (24.8)	21 (20.6)		216 (31.9)	
BMI before pregnancy (mean±SD, Kg.m ²)	23.6±4.7	23.9±5.3	0.518	23.7±4.5	0.463
<18.5	209 (6.8)	7 (7.4)	0.892	47 (7.1)	0.687
[18.5-25[1,986 (64.4)	58 (61.1)		411 (62.3)	
[25-30]	596 (19.3)	19 (20.0)		140 (21.1)	
≥30	295 (9.5)	11 (11.6)		62 (9.4)	
Geographic region of birth			0.443		0.829
France	2,254 (78.6)	81 (86.2)		457 (77.7)	
Europe	110 (3.8)	2 (2.1)		22 (3.7)	
North Africa	305 (10.6)	8 (8.5)		60 (10.2)	
Africa other	156 (5.4)	2 (2.1)		38 (6.5)	
Other	43 (1.5)	1 (1.1)		11 (1.9)	
Parity and previous cesareans			0.822		<0.001
Nulliparous	1,327 (41.6)	38 (37.3)		487 (72.2)	
Parous with no previous cesarean	1,769 (55.4)	60 (58.8)		144 (21.3)	
Parous with previous cesarean	98 (3.1)	4 (3.9)		44 (6.5)	
Smoker	439 (14.2)	18 (19.1)	0.178	84 (12.8)	0.326

History of diabetes	15 (0.5)	0 (0.0)	0.488	4 (0.6)	0.674
History of hypertension	20 (0.6)	1 (1.0)	0.657	6 (0.9)	0.444
In vitro fertilisation	615 (19.3)	21 (20.6)	0.746	228 (33.8)	<0.001
Pregnancy complications	605 (18.9)	20 (19.6)	0.865	178 (26.4)	<0.001
Hypertension	128 (4.0)	4 (3.9)		48 (7.1)	
Preeclampsia	187 (5.8)	6 (5.9)		98 (14.5)	
Placental abruptio	2 (0.1)	0 (0.0)		1 (0.2)	
IUGR for either twin	286 (8.9)	11 (10.8)		66 (9.8)	
Insulin-treated diabetes	84 (2.6)	2 (2.0)		20 (3.0)	
Placenta previa	6 (0.2)	0 (0.0)		1 (0.2)	
Twin-to-twin transfusion syndrome	36 (1.1)	0 (0.0)		3 (0.4)	
Premature rupture of membranes	241 (7.5)	9 (8.8)	0.629	44 (6.5)	0.354
Preterm labor	1,141 (35.7)	34 (33.3)	0.623	162 (24.0)	<0.001
Antenatal corticosteroids	1,293 (40.5)	37 (36.3)	0.396	206 (30.6)	<0.001
Induction of labor	1,489 (46.6)	35 (34.3)	0.015	464 (68.9)	<0.001
Oxytocin during labor	2,297 (72.6)	67 (65.7)	0.122	519 (78.8)	0.001
Noncephalic second twin presentation	1,209 (37.8)	46 (45.1)	0.136	271 (40.2)	0.246
Gestational age at delivery (gestational weeks) (mean)	36 6/7	36 4/7	0.169	37 2/7	<0.001
32 0/7-36 6/7	1,454 (45.5)	55 (53.9)	0.302	221 (32.6)	<0.001
≥ 37 0/7	1,745 (54.5)	47 (46.1)		455 (67.4)	
Intertwin delivery interval, Intertwin delivery interval (med (Q1-Q3), minutes)	6 [4-10]	18 [13-25]	<0.001	1 [1-2]	<0.001
General anaesthesia at 2 nd twin delivery	16 (0.5)	27 (26.5)	<0.001	32 (4.7)	<0.001
Instrumental vaginal delivery for 1 st twin	650 (20.3)	31 (30.4)	0.013	NA	NA
Instrumental vaginal delivery for 2 nd twin	529 (16.5)	0 (0.0)		NA	NA
Episiotomy	759 (23.8)	25 (24.5)	0.863	NA	NA

Birth weight 1 st twin (mean±SD, grams)	2,503.0±408.6	2,456.1±394.7	0.253	2,605.2±406.2	<0.001
Birth weight 2 nd twin (mean±SD, grams)	2,434.1±409.3	2,382.6±401.0	.211	2,500.9±418.3	<0.001
Annual number of twin deliveries			.096		.003
<50	1,185 (37.0)	48 (47.1)		214 (31.7)	
[50-99]	869 (27.2)	26 (25.5)		174 (25.7)	
≥100	1,145 (35.8)	28 (27.5)		288 (42.6)	
University hospital	1,374 (43.0)	37 (36.3)	0.180	325 (48.1)	0.015
Level of care			0.078		0.019
I	57 (1.8)	4 (3.9)		14 (2.1)	
II	1,312 (41.0)	49 (48.0)		238 (35.2)	
III	1,830 (57.2)	49 (48.0)		424 (62.7)	

BMI: Body mass index
SD: standard deviation
IUGR: in utero growth restriction

Table S3: Association between mode of delivery and severe acute maternal morbidity in the Twin Birth Study-like population and underlying causal conditions of severe acute maternal morbidity in each group

	Vaginal delivery of both twins	Cesarean delivery for the second twin	Crude RR (95% CI)	Adjusted RR* (95% CI)	Cesarean delivery for both twins	Crude RR (95% CI)	Adjusted RR* (95% CI)
	n=3,199	n=102			n=676		
	n (%)	n (%)			n (%)		
Severe maternal morbidity	150 (4.7)	9 (8.8)	1.9 (1.0-3.6)	2.1 (1.1-4.0)	66 (9.8)	2.1 (1.6-2.8)	1.6 (1.1-2.2)
Death	0 (0.0)	0 (0.0)			0 (0.0)		
Severe postpartum haemorrhage	129 (4.0)	9 (8.8)			53 (7.9)		
Blood transfusion \geq 4 RBC	25 (0.8)	2 (2.0)			14 (2.1)		
Uterine artery embolisation	19 (0.6)	2 (2.0)			4 (0.6)		
Vascular ligation, compressive uterine sutures	8 (0.3)	1 (1.0)			22 (3.3)		
Hysterectomy	4 (0.1)	1 (1.0)			4 (0.6)		
Pulmonary embolism	1 (0.03)	0 (0.0)			2 (0.3)		
Stroke or cerebral transient ischaemic attack	0 (0.0)	0 (0.0)			0 (0.0)		
Severe psychiatric disorders	1 (0.03)	0 (0.0)			0 (0.0)		
Cardiovascular dysfunction	2 (0.1)	0 (0.0)			1 (0.2)		
Respiratory dysfunction	1 (0.03)	0 (0.0)			1 (0.2)		
Renal dysfunction	7 (0.2)	1 (1.0)			7 (1.0)		
Haematological dysfunction	23 (0.7)	1 (1.0)			9 (1.4)		
Neurological dysfunction	0 (0.0)	0 (0.0)			0 (0.0)		
Emergency surgery	2 (0.1)	3 (2.9)			12 (1.8)		
Admission to an intensive care unit	22 (0.7)	1 (1.0)			15 (2.2)		

RBC: units of packed red blood cells

*Adjusted for maternal age, body mass index, parity, and previous cesarean delivery, in vitro fertilization, pregnancy complication, gestational age at delivery, induction of labor, oxytocin during labor, second twin presentation, macrosomia, annual number of twin deliveries per center